OVERVIEW INFORMATION:

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Dates: The following is a summary of the events and dates associated with the Robotics CTA PA:

EVENT	ESTIMATED DATE/TIMEFRAME
Draft PA released	7 August 2008
Opportunity Conference	27 August 2008
Open House	23 October 2008
Final PA released	02 February 2009
Proposals due	12 March 2009
Evaluation and Negotiations	May 2009-June 2009
Final Proposals due	July 2009
Award	January 2010

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Executive Summary:

1. <u>Purpose</u>: The purpose of this United States Army Research Laboratory (ARL) **Robotics Collaborative Technology Alliance (CTA) Program Announcement (PA)** is to solicit offers that will help fulfill the research and development goals of the U.S. Department of the Army. The Army envisions the Alliance will bring together government, industrial, and academic institutions to address research and development required to enable the deployment of future military unmanned ground vehicle systems ranging in size from man-portables to ground combat vehicles. It envisions a program that will focus upon Basic Research to explore new concepts and develop the technical underpinnings for future highly capable autonomous systems, as well as Applied Research directed towards the extension of those fundamental principles to relevant military applications and environments.

The objective of the Alliance is to conduct research creating the technical foundation supporting development of future autonomous unmanned systems. To achieve this objective the Alliance will advance fundamental science and technology in several key areas including the ability of unmanned systems to sense and fully understand the local environment in terms of both features and activities; the ability to interact intelligently with the surroundings to successfully conduct meaningful activity; individually or as part of a team, to readily adapt to changing situations and to learn from prior experience; the ability to be integrated safely and successfully into human activity; the ability to dexterously manipulate objects in a human-like fashion and to maneuver unfettered in cluttered, complex environments. The vision being pursued is the development of future highly capable autonomous unmanned systems that are an integral part of military teams, tasked like any other subordinate element to conduct a mission, be it area reconnaissance, clearing of confined spaces, unit resupply, or route clearance, with every expectation of complete success.

The Robotics PA identifies four technology areas that are likely to be critical to the development of future autonomous unmanned systems including air, ground, and surface vehicles of multiple scales. These key technologies are perception, intelligence, human-robot interaction, and dexterous manipulation and unique mobility. Additionally, this PA emphasizes the overlap and interplay between each of these technologies and the requirement to consciously consider the integration of each of these technologies into appropriate testbeds or surrogates in order to understand and optimize the performance of future systems. Thus, in addition to technology development the Alliance will also focus upon relevant integration and assessment activities. As part of the technology integration and assessment activities, the Consortium will be responsible for providing, maintaining, and continually upgrading instrumentation, testbeds, and specialized facilities required to conduct this program.

To accomplish this mission, this PA describes the Army vision for a consortium of a small number of industrial and academic institutions acting as equal partners in a research enterprise. The consortium will partner with the Army Research Laboratory and other Government agencies to advance technology by conducting a number of individual, coordinated research tasks based upon a series of consistent, yet flexible annual research plans that will be highly responsive to the needs of the Army and Department of Defense (DoD). These plans will include the interchange of scientists and engineers from among the Alliance participants, as well as educational opportunities that will serve to strengthen the ability of the Alliance and the larger research community to create future

military unmanned systems. It will utilize experimental facilities and testbed platforms provided by both the Consortium and the Government to conduct technology integration and subsequent performance evaluation. A key measure of success for this effort will be the rapid and timely transition of technology to Army and DoD Advanced Development and acquisition programs.

2. Program Components: This CTA consists of two components: (1) the Fundamental Research Component; and (2) the Technology Transition Component. The Fundamental Research Component will provide for research, the results of which will be in the public domain. The fundamental research component will be a collaborative undertaking of the Consortium and the Government. It will focus upon conducting research in the four primary research areas: perception, intelligence, human-robot interaction, and dexterous manipulation and unique mobility. It will integrate the hardware and software algorithms resulting from the collaborative research onto a representative set of technology testbed platforms for assessment of technology performance and demonstration of achieved technical capabilities. The Technology Transition Component will provide for the application of the fundamental research results to military and other Government applications.

3. Award Instruments: This PA will result in the award of two instruments: (1) a cooperative agreement as defined at 31 U.S.C. 6305 for the execution of the Fundamental Research Component; and (2) a procurement contract as defined in 31 U.S.C. 6303 for the execution of the Technology Transition Component that will be awarded to the Integration Lead Organization of the selected Consortium. The cooperative agreement for the Fundamental Research Component will be awarded to a Consortium of academic and industrial organizations. To assure the creation of a well focused research program, the consortium will be kept small, ideally with approximately six members. The consortium will be led by an organization that will be charged with spearheading the technology integration and technology transition efforts. This organization will be designated as the Integration Lead Organization (ILO) and its CTA activities shall be conducted in the United States. There will be no limitation to the place of performance for other organizations participating in the Consortium. However, Consortium activities conducted under the Technology Transition Component of the Alliance and directly related to military applications may come under the jurisdiction of the International Traffic in Arms Regulation (ITAR) and appropriate controls must be in place when foreign entities are part of the Consortium. Additionally, the Consortium must include an HBCU/MI member(s) that will participate substantially in the research effort and receive at least 10% of the funding for the Fundamental Research Component. The Consortium will function as a collective of equal partners deciding upon all Consortium matters equally. Since unmanned systems draw upon a broad palette of technologies, it is expected that the Consortium will be enhanced by a constantly changing group of additional researchers and research organizations chosen jointly by the Consortium and the Government to complement research already undertaken by the Consortium and Government. These researchers and research topics, while part of the annual program plan, will be subawardees to one of the Consortium partners and not part of the Consortium proper. Ten percent (10%) of the annual research effort may be devoted to novel and innovative research conducted by these subawardees.

4. Articles of Collaboration: The Articles of Collaboration define the operational structure within the Consortium. An attachment to the PA provides a sample Articles of Collaboration for

offerors to consider in preparing proposals; however, offerors are free to modify this document as necessary and appropriate to coincide with their proposal. The Articles of Collaboration included in the proposal will be evaluated under the Management evaluation factor. Proposals must include a copy of their proposed Articles of Collaboration, signed by a duly authorized representative for each Consortium member.

5. Period of Performance: Awards made as a result of this PA will provide for a period of performance of five years, with an optional five-year extension period.

6. Place of Performance: Performance by the ILO is limited to the United States in order to facilitate future technology transition. Other Consortium Members or subawardees may be located and perform at any location.

7. Funding: This PA is issued subject to the availability of funds. The PA provides the estimated funding levels for the Basic Research (6.1) and Applied Research (6.2) components of the program. ARL has submitted the requisite documents to request funding for the period covered by the cooperative agreement; however, offerors are reminded that this request is subject to Presidential, Congressional and Departmental approval. **The funding levels provided in the PA are for proposal preparation purposes only. The actual funding level of the cooperative agreement will be updated annually as part of the appropriation process**. No funding is currently designated for the Technology Transition Component. Funding for the Technology Transition Component under the procurement contract is expected to be received from Government organizations as opportunities for transition of technology from the Fundamental Research Component are identified for specific military applications.

8. Profit/Fee: Profit/fee is not permitted under the cooperative agreement for the Fundamental Research Component. Profit/fee will be permitted under the Technology Transition Component for the specific transition tasks executed under the procurement contract. The rate of profit/fee will be negotiated on a task-by-task basis, in accordance with DFARS 215.404-4, based on the technical and performance risk associated with the specific task being executed.

I. FUNDING OPPORTUNITY DESCRIPTION

A. PROGRAM BACKGROUND

New realities demand innovative concepts to focus the talent of industry and academia on critical technology needs of the Army. Twelve years ago the ARL responded to the challenge by changing the way it did business. The new strategy focused in-house laboratory research on Army-specific business areas while establishing extramural centers of research in areas where state-of-the-art expertise could be leveraged to satisfy Army technology needs. The combination of government, in-house, industry, and academic components striving together for excellence created a new paradigm for Army research - a "federated laboratory." The FedLab concept proved to be an overwhelming success, a “win-win” situation for all concerned – ARL, the private sector consortia members, and the Army system developers. It was awarded the Hammer Award for Reinventing Government by former Vice President Al Gore.

The Collaborative Technology Alliance (CTA) Program is the follow-on to the FedLab Program and, on 31 May 2001, and as a result of a competitive process, ARL established five CTAs in the areas of Advanced Sensors, Power & Energy, Advanced Decision Architectures, Communications & Networks, and Robotics. The success enjoyed by these alliances later led to the formation of the Micro Autonomous Systems and Technology (MAST) CTA in 2008.

The Robotics CTA (RCTA) was established in 2001 to conduct Applied Research in robotics for a period of five years with an option to extend the Alliance for an additional three years based upon the results of a formal review. In spring 2005, an independent team of government scientists and engineers conducted a review of the RCTA program. The findings of the team were presented to a General Officer level Executive Steering Board (ESB) that decided to exercise the option to extend the period of performance for the CTA. The ESB also recommended the addition of a Basic Research component to the program and the requirement to conduct research to support the future development of unmanned systems for the Army’s Future Combat Systems program. While deemed highly successful, the current RCTA is scheduled to conclude before award is made in connection with this PA. Further information concerning the current Robotics CTA can be found at http://www.arl.army.mil/www/default.cfm?Action=93&Page=156 .

The purpose of this Program Announcement is the creation of a new, successor CTA to conduct research supporting the development of future advanced, highly autonomous unmanned systems for the Army and other DoD organizations. The proposed new CTA is modeled after the original CTAs and continues the paradigm of collaborative research involving government, industry, and academia. The projected scope of the new Robotics CTA Fundamental Research Component is approximately $63.2 million over the first five years and $66.5 million for a five-year option. The Robotics CTA will conduct a combination of both Basic Research for development of fundamental technology and Applied Research that will focus research results towards military specific applications. ARL’s strategy is to continue exploiting technology and expertise where it exists through the issuance of a single award through this Program Announcement to a consortium of academic and industrial partners that will work with ARL scientists and engineers to help fulfill critical military modernization objectives.

ARL and the Consortium selected for award, will establish one collaborative research Alliance to address research topics critical to future unmanned systems. While the research will be focused primarily upon the ground domain, it is anticipated that research results will be cross-cutting and extend to all unmanned systems including air, ground, and surface vehicles. Research will concentrate upon the intelligence necessary to create future highly autonomous unmanned systems and permit them to effectively conduct military operations in mixed environments. Those operations are projected to run the gamut of military activity including combat (e.g., both mounted and dismounted reconnaissance in open and urban terrain including operations in confined spaces), combat support (e.g., countermine, CBRNE detection & mitigation, and force protection), and combat service support (e.g., logistics) operations. Alliance research will focus upon four technology areas: perception or the ability of the system to understand its local environment; intelligence or the ability of the system or systems to create and execute a plan of action based upon its knowledge of the local environment, commander's intent, and a priori knowledge; human-robot interaction or the interaction of unmanned systems with humans, including combatants and non-combatants; and dexterous manipulation and unique mobility or the ability of the system to manipulate objects in near human-like fashion and to maneuver through complex terrain or confined spaces.

Additionally, other Government agencies will be invited to join this Alliance and to contribute, as appropriate, their technical expertise and personnel and to participate in the Robotics CTA. This intellectual synergy will include sharing equipment and facilities to promote efficiency. A significant goal of this effort will be to create a critical mass of private sector and Government scientists and engineers focused on solving the military technology challenges in the autonomous operation of unmanned systems as well as supporting and stimulating dual-use applications of this research and technology to benefit commercial use. To achieve this, the Alliance is expected to produce advances in fundamental science and technology, demonstrate and transition technology, and develop research demonstrators for warfighter experimentation.

B. FUNDAMENTAL RESEARCH COMPONENT

1. Introduction: The Fundamental Research Component will be funded under a combination of the 6.1 (basic research) and 6.2 (applied research) budget categories. The budget category used to fund each task listed in the Annual Program Plan (APP) will be unique and will be clearly designated as part of the APP. The research proposed is expected to comply with the appropriate funding definitions as follows:

> Budget Activity 6.1 – Basic research is systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. It includes all scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. It is farsighted high payoff research that provides the basis for technological progress. Basic research may lead to: (a) subsequent applied research and advanced technology developments in Defense-related technologies, and (b) new and improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and

control, navigation, energy conversion, materials and structures, and personnel support.*

Budget Activity 6.2 – Applied Research: Applied research is systematic study to understand the means to meet a recognized and specific need. It is a systematic expansion and application of knowledge to develop useful materials, devices, and systems or methods. It may be oriented, ultimately, toward the design, development, and improvement of prototypes and new processes to meet general mission area requirements. Applied research may translate promising basic research into solutions for broadly defined military needs, short of system development. This type of effort may vary from systematic mission-directed research beyond that in Budget Activity 6.1 to sophisticated breadboard hardware, study, programming and planning efforts that establish the initial feasibility and practicality of proposed solutions to technological challenges. It includes studies, investigations, and non-system specific technology efforts. The dominant characteristic is that applied research is directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters. Applied Research precedes system specific technology investigations or development.*

It is the responsibility of the offerors to suggest how they would optimize the use of the available funds in order to further the Robotics CTA objectives. It is the intent of this PA to solicit the most creative, innovative, and flexible approaches to the ultimate goal of generating and exploiting technology to solve pressing technical issues impacting both the military and commercial sectors. Offerors responding to this PA are expected to fully discuss proposed Basic Research activities down to the task level, including research goals, anticipated timelines for achieving intermediate and final objectives, and identification of personnel anticipated to conduct this research, to include the qualifications of those researchers. Offerors are also expected to identify how the results of the Basic Research component will transition into specific Applied Research activities that will address technology gaps to the fielding of future highly autonomous unmanned systems, and are expected to provide a detailed roadmap identifying how the Applied Research element of the program will address those gaps. The proposal should include a discussion of technology integration activities to include plans for the quantitative assessment of integrated performance, development, and maintenance of appropriate testbeds and facilities. The proposal should also include discussions for mechanisms for collaborative research activities between Consortium partners and between Government and Consortium researchers.

While the following paragraphs discuss research issues that the Government considers important to the fielding of future unmanned systems, offerors may propose to alter the choice of research issues to further the Robotics CTA goals. An offeror may propose to investigate additional research issues, or to deemphasize research issues suggested in this PA. Additionally, all results of the Fundamental Research Component must be publishable without constraint in the public domain.

2. Definition, Scope, and Rationale

Operations Enduring Freedom and Iraqi Freedom have demonstrated the value of robotic platforms, both aerial and ground. Armed remotely piloted UAVs have become valuable tools for soldiers in

* From DoD Financial Management Regulation, Volume 2B, Chapter 5, June 2006

both theaters; Explosive Ordnance Disposal (EOD) robots have become essential tools for the identification and disarming of Improvised Explosive Devices (IEDs). However, these initial systems rely upon teleoperation involving high bandwidth communications links and intense interaction with human operators that limit functionality and utilization.

Unmanned systems technology will be a key component of the Army's Future Combat Systems (FCS), providing initial capabilities for semi-autonomous operation when FCS is fielded in the first half of the next decade. While these systems will assist the soldier in conducting "dull, dirty, and dangerous" missions, the Army's vision for future robotic applications calls for systems of various size scales, including man-portable robots, employing increasing levels of autonomy required to conduct a wide variety of missions from area reconnaissance, to reconnaissance of interior and confined spaces, to countermine operations, to CBRNE detection, to force protection, and logistics operations such as unmanned convoys.

These systems possess a number of cross-cutting characteristics that will be common across a broad spectrum of missions and platforms. Unmanned systems must be sufficiently robust and flexible to successfully function in difficult environments with limited foreknowledge of conditions. They must be able to learn from prior experience be adaptable to changing conditions and situations. They must be able to smoothly interact with humans to minimize the cognitive workload placed upon the soldier controlling the system, as well as enable the system to be effectively employed in mixed environments.

The capabilities described previously span four technical areas: perception, intelligence, human-robot interaction, and dexterous manipulation & unique mobility. In each technical area the Robotics CTA shall conduct Basic Research focused upon investigating new concepts and conducting fundamental research that will have applicability to a wide array of technologies,. In each of these areas the CTA will then take those Basic Research results and apply them to technology that is more intimately associated with military applications. These latter research activities will be funded under the Applied Research component of the program.

While the proposed research portfolio has been divided into four distinct areas, significant overlap and interplay exists between each of the areas. Additionally, robotics is characterized by the effective integration of these technologies. Thus, it is not possible to understand the full impact of research until it is incorporated into functional testbeds that can be exercised in relevant environments. Hence a key component of the Robotics CTA, primarily as part of the Applied Research element, will be the integration and assessment of multiple technologies to determine integrated performance levels. Additionally, the Consortium is expected to establish and maintain a comprehensive set of testbeds required for technology integration and assessment activities as part of its efforts. These may include testbeds that already exist, are part of cost sharing proposed by the consortium, purchased or developed under the Robotics CTA within the available funds, or currently available within the Government. Examples of ARL testbeds that could be utilized as part of Alliance research activities were part of the 23 October Open House. The following paragraphs will outline some technical barriers to achieving desired future unmanned system performance for each of the four technical areas that will form the basis for the Robotics CTA. Fully addressing all these issues could overextend the resources available for this CTA. In light of the Army objectives for future applications of unmanned systems, offerors are asked to consider and prioritize these

issues, as well as to add or substitute others that they may consider of equal or greater importance and to then propose a detailed, creative, balanced research portfolio to achieve these overall goals.

3. Robotics Collaborative Technology Alliance (CTA)

a. Perception:

Perception encompasses the ability of a system to perceive and understand its environment, placing it into context so that the unmanned system can plan and execute meaningful activity. It requires the ability of a system to effectively sense its surroundings under all operational environments, the ability to effectively fuse data from multiple sensory streams, the ability to reason about where to look and identify salient features, the ability to recognize objects and behaviors placing them into an iconic four dimensional model of the surrounding world. Until recently the majority of perception research has focused upon requirements for navigation in static environments, namely obstacle detection and terrain classification, and upon recognition of objects for mapping. More recently this has broadened into perception for dynamic environments including initial attempts at behavior recognition.

It is anticipated that unmanned systems will require significantly more advanced perceptual capabilities to autonomously conduct military missions in the complex and dynamic environments characteristic of future operations. They must be capable of segmenting a complex dynamic scene into meaningful elements, utilizing a broad vocabulary of descriptors to label both objects and behaviors. Systems must adapt to unknown and changing environments. Capabilities must be scalable, effectively employing the limited sensory and computational capabilities resident upon small back-packable robots, as well as utilizing the enhanced capabilities of larger systems.

Sensing is the most fundamental element of perception. The current range of sensor technologies being employed for unmanned systems include active LADAR, both two and three dimensional scanners, as well as flash LADAR and radar; passive EO/IR, including both multi-sensor stereo vision and motion-based stereo. Some inroads have been made towards employing focus of attention to improve the saliency of sensory data and use of a biomimetic foveal paradigm to obtain improved resolution at greater ranges. However, current technology still lacks the ability to function well in all environments, including limitations of visibility due to natural and made-made obscurants. The sensory data typically obtained is too coarse to permit desired high-speed autonomous mobility or sufficiently detailed to clearly identify objects, such as combatants vice non-combatants at desired ranges, or to provide sufficient detail to detect targets in significant levels of clutter. Researchers often fail to take full advantage of all available sensory information, perhaps due to the high computational cost of processing. Available sensors often do not scale well, in many instances with capable sensors available for larger systems but nearly totally lacking for smaller UGVs or Class I UAVs.

The ability of an unmanned system to classify and identify terrain and objects is elemental to its ability to maneuver through an environment safely and securely to conduct a tactical or support mission. Today's technology utilizes a significantly constrained vocabulary of identifiers, focusing primarily upon noun-like labels, lacking the adjectives and prepositions that mark

human conversation and understanding. It relies upon fairly well defined templates for objects focusing primarily upon single characteristics, e.g., geometric or appearance. Future systems will require a significantly richer vocabulary, able to describe a wide array of scene elements that might provide cues or tactical information to aid the unmanned system in conducting its mission. These systems must be able to reason about context and observability to aid in scene decomposition and identification of salient features. Object classification algorithms must be robust and adaptive to changes in the environment and context, as well as to object scale and orientation. They must be both quantitative, e.g., accurately register object locations to permit local path planning, and qualitative, e.g., identify a potentially traversable path at long range from limited data.

Terrain classification refers to a static world of objects, but most military activity occurs in highly dynamic environments with a concomitant requirement to detect and understand the behavior and activity of others. Today's technology is focused upon a limited set of activity, often identified with a structured environment, e.g., the DARPA Urban Challenge, that only begins to approximate the broad understanding necessary to survive in a tactical environment. To possess true situational awareness, future systems will have to reason about likely behavior based upon context and cues, as well as the saliency of observations to limit the search space and improve tractability. The systems will have to reason about intent, based upon observed activity and the context in which it occurs. Researchers will have to develop a vocabulary of activity with sufficient granularity and robustness.

Future unmanned systems will not act in isolation, but will be teamed either with soldiers or with other unmanned systems. These teams will be both homogeneous and heterogeneous, with the latter suggesting the potential for varying levels of perceptual capability and possibly complementary capabilities, e.g., FCS MULE UGVs and Class I UAVs. To obtain optimal benefit from these systems, one might consider distributed perception (i.e., fusing of low-level data from multiple sources) or collaborative perception (i.e., higher level fusion of data or information obtained from systems with varying levels of capability or perspective).

b. Intelligence:

Future robotic systems will utilize intelligence to accomplish missions and tasks that support the overall goals of its military unit. This intelligence will enable the robotic systems to extend the current case-based reasoning process to a probabilistic process that treats the uncertainties of the battlefield environment in a systematic fashion. An important characteristic of this intelligence is the ability to adapt and learn, using knowledge and skills gained in one domain to solve related problems in other domains. Self awareness and introspection (meta-cognition), provides the robot the means to evaluate progress toward the completion of a task, abandon unsuccessful plans, and to devise new plans to improve the probability of successfully completing tasks. Such awareness also helps the robot devise strategies to learn new skills and enables effective communications with other entities, allowing robots to explain its actions and reasoning processes. Military robots are likely to work as part of a mixed robotic human team. Bounds on autonomous decisions and actions will ensure that robotic systems conform to acceptable behavioral and social norms set by the humans around them.

The ability to learn and adapt will ensure that robotic systems will be able to operate effectively. Machine learning is a large and diverse field. Future research may be focused on problems that enable the robot to operate in the battlefield environment, employing learning techniques to help prepare robots for missions in situations or environments possessing significant numbers of unknowns. Deductive reasoning and generalization will permit robots to adapt to various environments and situations encountered on the battlefield. Understanding of the relationship and interplay between long and short term memory as well as knowledge management to allow robots to retain and reuse knowledge gained over time in a variety of environments should improve the adaptability and reliability of future systems. The size of the robotic platform may be tailored to specific missions. It will also impact the amount of computational resources available. It will be necessary to scale algorithms to fit the available resources. Advances in meta-cognition are needed so that the robot can explain and reason about its actions, providing transparency of actions that will be critical to successful human-robot interaction.

The ability to learn will result in the ability of robots to perform complex and adaptable behaviors. Ideally, one would like to move beyond the scripted behavior sequences possible today to adaptable behaviors that use or discard subtasks in response to events on the battlefield. This requires task prioritization and monitoring that enables the robot to respond to the commander's intent. It also requires incorporating precepts such as "Rules of Engagement" or cultural context into robotic behaviors. Planning algorithms need to be extended to include planning for uncertain environments and task allocation for teams of robots. Collaboration will continue to be an important topic with research needed in robot/robot collaboration, robot/human teaming and mixed initiative missions

Robotic systems should have transparent reasoning processes to allow developers and users to understand the robot's past actions and to anticipate its future actions. While most of the research in this area is in the field of human robot interaction, research in reasoning, explanation and evaluation can help develop effective tools to foster human-robot interaction. These same tools will allow the robot to monitor its own progress, evaluate failures and possibly develop learning strategies to correct future failures. In the context of a tactical mission, effective graphical and verbal explanations as well as non-verbal cues will allow the robot and human to communicate intended actions impacting the safety of nearby soldiers and the trust they have in unmanned systems. Developing useful metrics and performance indicators, as a part of the behavior development process, will allow robots to gauge performance and to communicate that information to other team members.

Research in intelligence needs to be strongly linked to research in perception. Robots must build and maintain a usable representation of the world that includes both static and dynamic features. This world model must be continually "managed" and validated against both preconceived models and contextual understanding to uncover anomalies that may portend impending system failures or provide valuable cues to potential changes in the environment. Unmanned systems must possess a level of scene understanding that permits the robot to not only extract features from the scene, but to reason about the observed activities and features. These systems must possess internal representations of the world capable of supporting processes such as reasoning

and learning, and be communicated to other entities such as soldiers or other robots facilitating successful achievement of operational objectives.

c. Human-Robot Interaction

For the foreseeable future, unmanned systems will not be truly autonomous, but will be guided by and work with soldiers at some level of the Command and Control structure. The unmanned systems may be single platforms or multiple heterogeneous teams. Soldier-robot systems may conduct a range of potential missions using autonomous systems as partners or subordinates in varied operational environments, with both mounted and dismounted Warriors. Improved understanding of the interaction between soldiers and unmanned systems appropriate to each mission will improve the overall effectiveness of employment for these systems.

Soldiers will collaborate with robots as partners and team members. Soldiers and robots will require a shared situational awareness and understanding and "common ground." This will entail the mutual ability to understand soldiers' intent and then execute that intent. Unmanned systems will need to understand and act on human intent while humans will need to be able to understand, and direct as needed, unmanned systems' intent. Common frames of reference, both spatial and temporal, will be key characteristics of the "common ground." Soldiers may need to work in close physical proximity to robots in dynamic interaction, thereby requiring mobility planning in close quarters to humans. Soldier trust and confidence, appropriately calibrated, in the unmanned systems will enhance their effective use. Collaboration will entail variable levels of autonomy, with mixed initiative for action and control.

Soldiers will require intuitive means for communication with the unmanned systems to fully realize collaboration. Non-traditional means to promote intuitive communication will likely aid soldiers-robot interaction. Use of language, non-verbal cues, and unconstrained dialogue will enhance the ability of the soldier to communicate to both other humans and systems while interacting with the robots. This will require understanding of the subtle cues and expressions, gestures, speech used by humans in everyday activity. In order to use cues, the unmanned system must be able to perceive the cues and use intelligence to build a context for interaction. The robot may also need to communicate through behaviors and appearance that engender appropriate human responses. Communications must be understandable with interruption and resumption, in high tempo environments.

To meet the Army's ultimate vision for the utilization of unmanned systems it will be necessary appropriately integrate unmanned systems into society, particularly into the interaction with soldiers within military contexts. Robots may also encounter other humans (other than friendly soldiers) during military missions such as combat in urban terrain, combat service support missions and Security and Stabilization Operations (SASO). There will need to be a shared understanding of the social context within which operations take place and the ability to interpret and act on social cues and maintain appropriate interaction with humans.

A better understanding of the limits to the span of control of soldiers over unmanned systems, e.g., with many soldiers controlling many robots, will be required. Future applications will undoubtedly utilize a network of manned and unmanned systems collaborating to successfully

conduct combined missions. Distributed decision-making will be necessary to permit soldier-robot teams to properly coordinate mixed initiative missions. Enabling these activities will require robot leaders controlling less capable agents based upon intent information supplied by the operator. The collaboration among soldiers and unmanned systems will be a function of (1) communications protocols, (2) distributed intelligence, (3) interfaces that allow the operator to understand and supervise multiple courses of action for unmanned systems, and (4) trust and supervisory performance. Modeling, simulation, and field testing can help define Solder-robot teaming roles during future complex military engagements.

d. <u>Dexterous Manipulation and Unique Mobility:</u>

Research in this technical area should be focused on increasing the level of knowledge and capabilities for robotic manipulation and mobility. These objectives cover the full range of control and configuration of robotic manipulators and mobility systems. Robotic manipulation and mobility systems are linked through the commonality of perception, control, and physical system issues. Both technology subsets are currently limited by the reliance on teleoperated control, fixed configurations with limited joint movement, low applied power to energy consumption, and lack of high fidelity sensor feedback. This technical area will be focused on advancing the state of the science to achieve a high level of manipulator automation with high fidelity feedback and adaptable, efficient means of all-terrain mobility.

The issue of manipulator automation is traditionally addressed through the use of scripts in a controlled environment. Unfortunately military systems often operate in unknown and unstructured environments that make the use of scripted behaviors difficult to implement. This problem requires that effective robotic systems have manipulator control systems that are adaptive and closely tie perception to action. For those critical tasks that demand human teleoperation of the manipulator, the current feedback mechanisms are poor with low fidelity and limited perception. A higher level of fidelity and quality of information is needed to enable effective teleoperation for critical tasks.

A major consideration for manipulators is that robotics systems work in a human world. All of our tools, devices, doors, furniture, and appliances are designed around the human, our range of motion, and manipulation capabilities. Effective, generic robotic manipulators for military applications need to be able to at least replicate and preferably exceed the range of motion, grasping capabilities, and strength of a human to be able to work in our world and manipulate our devices. The manipulators should be able to grasp and turn a door knob, pick up a tiny screw, and even gently care for a patient's wounds as well as pick up or move heavy objects. These capabilities may not be limited to hand like devices as specialized end effectors have significant advantages for specific tasks.

It may also be necessary to further develop technologies that will enable more efficient manipulation. Biological limbs deliver a far greater force to power consumed than their electro-mechanical counterparts. The current state of the art for artificial muscles and similar technologies is in its infancy, but shows great promise to deliver the range of motion and power economy that future robotic systems will require.

Robotic mobility has been given a great deal of attention with many varied systems and types of locomotion being developed. The capability gap in robotic mobility continues to be in the intelligent control of the mobility system to enable a high level of autonomous navigation. There are current mobility systems that can traverse all types of difficult terrain from very soft ground to large boulder fields and even vertical walls, but the common problem continues to be the lack of effective control systems that can recognize the different terrain conditions and the mobility modes required to traverse that terrain.

Animals very easily adapt and change their mobility mode depending on the type and condition of the terrain that they encounter. When faced with uneven difficult terrain, humans and animals change their gait and possibly even their mobility mode while also increasing their dependence on all their perception capabilities. For example, when transitioning between walking on flat terrain to climbing stairs an animal or human will change their gait from walk to step climb, put more dependence on the feeling from their feet as they climb, and put more dependence on their internal sense of balance to avoid falling forward or backwards. This is just one simple example of many different types of everyday mobility problems that are very difficult for robotic mobility.

Current robotic mobility systems are specialized for a particular type of mobility. There are wheeled systems for high speed travel, tracked systems for moderately rough and soft terrain, articulated systems for stair/ledge climbing, legged systems for low speed rough terrain, and even a combination suction/crawling systems for wall climbing. There a two major issues with the current approach. First, the mobility control systems are still very primitive with minimal ability to learn and implement new gaits and modes in situations where the scripted behaviors fail. The control systems typically rely on very limited feedback and have an incomplete picture of the situation which leads to incorrect action and mission failure.

Second, the reliance on fixed mobility configurations severely limits the areas and terrain that a particular system can traverse. Almost all animals have the ability to alter their body shapes and assume appropriate mobility modes for the terrain they encounter. Humans alone can crawl, walk, skip, run, roll, climb, swing, jump, and even swim. This gives them the necessary mobility to operate in all but the most extreme terrain environments without the use of tools. Adaptive locomotion and non-traditional machine mobility may enable future robotic systems to possess a vastly improved ability to maneuver effortlessly through complex three dimensional environments.

4. Funding

Table 1 presents the estimated funding levels for the Fundamental Research Component to be conducted under the Cooperative Agreement over the projected period of performance, including option years. The projected funding includes all costs associated with the Cooperative Agreement, i.e. the research costs, costs to manage the program, develop and maintain testbeds, etc. The table makes two key assumptions: (1) award of the cooperative agreement will be in the second quarter of FY10 and the program will ramp up with start-up activities during the second quarter resulting in less than full funding during the initial fiscal year of operation (i.e., the funding identified for FY10 in Table 1 is the amount of funding anticipated for the start-up year

and as such it is less than the annual funding for subsequent years) and (2) planning numbers for Basic Research for the Robotics CTA that are currently part of the FY09 President's budget indicate increased funding in the Program Objective Memorandum (POM) outyears.

Initially, this agreement is expected to be funded partially with FY10 basic research funds. Both the Defense Appropriations Acts of 2008 and 2009 contained a provision such that no basic research funds made available under the acts could be used to pay indirect costs that exceed thirty-five percent of the total amount of the agreement for basic research. Further, the acts indicated that indirect costs exceeding thirty-five percent of the total amount to be reimbursed from that appropriation would be considered unallowable and would not be reimbursed. Further it stated that should subsequent audits indicate indirect costs exceeding thirty-five percent of the total amount paid from the appropriation were disbursed, the recipient would be required to refund the amount over the statutory limitation to the Government. While it is unknown whether such a provision will be included in the Defense Appropriation Act of 2010, offerors are to indicate in their cost proposals their plan for compliance with such a provision, should such be included in the Defense Appropriation Act of 2010.

Additionally, offerors should not assume equal levels of funding for each of the four research areas, but should prioritize funding based upon the goals of research portfolio presented in the proposal. As a reminder, the funding levels provided in this PA are for proposal preparation purposes. The actual funding levels for Cooperative Agreement will be updated annually after the US appropriation processes. Finally, the Cooperative Agreement has a requirement that at least 10% of the funding for the Fundamental Research component of the program be distributed to the HBCU/MI consortium member(s).

Funding Category	**Fiscal Year**											
	FY10	FY11	FY12	FY13	FY14	**Total (5yr)**	FY15	FY16	FY17	FY18	FY19	**Total (10yr)**
Basic Research	2.6	4.8	4.9	5.0	4.3	**21.6**	4.3	4.3	4.3	4.3	4.3	**43.1**
Applied Research	5.6	9.0	9.0	9.0	9.0	**41.6**	9.0	9.0	9.0	9.0	9.0	**67.6**
Total	8.2	13.8	13.9	14.0	13.3	**63.2**	13.3	13.3	13.3	13.3	13.3	**129.7**

Table 1. Anticipated Robotics CTA Funding

Given the significant length of the proposed period of performance (including option years), it is not possible to foresee all changes in operational and technical requirements for the program or the direction of technology development over the total life of the CTA. Therefore it is possible that the mix of expertise available to the Alliance will be required to evolve over the course of its lifetime. As part of this Program Announcement provision is being made for the Alliance to continually renew itself by scouring the research community for new and relevant ideas and concepts, including the incorporation of new research partners. To achieve the continued

infusion of new concepts into the Alliance, it is expected that beginning in FY11 with the first Annual Program Plan, 10% of the proposed funding will be devoted towards new and innovative research conducted by a continually changing group of subawardees. These tasks may be elements of either the Basic Research or Applied Research components of the program and are expected to complement the ongoing research. Offerors, as part of the proposal, are invited to propose mechanisms for proposing and evaluating new research topics under this element of the Alliance. Additionally tasks falling under this element of the program shall be identified in a separate portion of the Annual Program Plan document.

These novel research projects are expected to be funded under the Robotics CTA cooperative agreement by entities not currently members of the Consortium, i.e., these entities will be considered subawardees. That means for year FY11 and beyond, offerors proposals should include the use of proposed subawardees for 10% of the funding for the Robotics CTA. It is recognized that as this 10% funding is for novel research projects, the identities and scope associated with such research projects may not be known beyond FY12. Thus, the cost proposal should show specifically proposed projects through FY12 and provide some general plans for FY13 and beyond based on previous experience and the offeror's proposed approach to the scope and research issues associated with the Robotics CTA.

It is recognized that award will be made to the Consortium that offers the best value to the Government. Thus, the participation of those Members is considered extremely important during performance. However, Members must recognize and understand that there are no guarantees associated with the levels of funding for each Member during performance. All Members may be expected to compromise and sacrifice funding to their organization as necessary and appropriate to meet the goals and objectives of the Robotics CTA as established through the collaborative planning process during performance.

C. TECHNOLOGY TRANSITION COMPONENT

This PA contains a requirement for a Technology Transition Component to augment the Fundamental Research Component. The results of the Fundamental Research Component will be transitioned under a procurement contract. This contract will be awarded to the ILO for the Consortium. The ILO is expected to subcontract with other entities (both members of the Consortium and other organizations as appropriate) to achieve the technology transition efforts. Offerors will prepare a separate chapter of the proposal discussing their approach towards the technology transition component of the Alliance. The following represents a discussion of the Technology Transition Component that will be incorporated into the contract as the umbrella scope under which individual, specific tasks will be negotiated and issued, when transition opportunities arise and the appropriate type of funding for such is identified.

1. Background

The contract is intended to provide analytical resources and support to exploit technology transition opportunities that arise from the Fundamental Research Component of the Robotics CTA. This instrument will provide a mechanism to expeditiously transition the results of efforts performed under the Fundamental Research Component. The goal of the Technology Transition

Component is to facilitate movement of the research further along the acquisition cycle toward specific applications.

2. Objective

The contractor shall support the Robotics CTA in pursuing and performing technology transition efforts. Technology transition is the exploitation of results generated under the Fundamental Research Component in specific applications of interest to the Army. Specifically, the contractor shall perform individual tasks relating to the following objectives:

- To respond to ARL or other government customers who wish to alter, modify, augment, accelerate, and/or expand specific results of the Fundamental Research Component in order to fulfill a specific developmental requirement; and
- To respond to ARL or other government customers who have requirements for the expertise and/or results emerging from the Fundamental Research Component, and the integration of those results on the customer's application; and
- To support ARL or other appropriate government customers in bringing technology from the Fundamental Research Component to a planned demonstration or exercise as appropriate.

3. Scope

The following describes a sampling of the types of technology transition tasks envisioned to support the objectives above:

- The contractor shall: (a) conduct specialized analyses, studies, and experimentation necessary to assess the applicability of technology; and (b) develop specific plans for the transfer of technology to targeted applications.
- The contractor shall: (a) prepare descriptive material that clearly details the scope, limitations, and requirements for implementing the specific technology; (b) provide an exemplar of the technology for incorporation into the target system for demonstration and/or experimentation as appropriate; and (c) assist in the integration of the technology into the target platform (platform could be computer software, as well as a physical entity) for demonstration and/or experimentation as appropriate.
- The contractor shall perform demonstrations and field experiments as required to promote transitioning of the technologies developed under the Fundamental Research Component. The statement of work for the tasks will be expected to define the mechanism for the demonstration or experiments as appropriate.

4. Reports

The following are examples of reports which may be required for a task: Technical Study Reports, Software Design Documentation, Software Systems Manuals, Interface Design Documentation, Interface Requirements, Database Design Documentation, Engineering Drawings, Engineering Specifications, Engineering Change Documentation, Workshop and Conference Reports, Instructor/Lesson Guides, etc.

- The contractor shall submit performance and cost reports, when required by the particular task that reflects the number of labor hours and labor costs charged against the task, cost of materials, travel, per diem, indirect costs, and total cost accumulated under the task. This report shall include the current status of the work, problem areas encountered, current projections of completion dates and estimated total cost to complete the order. Any changes to previous projections shall be explained.
- The contractor shall submit progress/meeting reports, when required by the task.
- The contractor shall submit status reports, when required by the task.
- The contractor shall submit technical progress reports, when required by the task.

5. Funding

It is expected that ARL and appropriate Other Government Agencies/Departments (OGA/OGD), as well as other ARL customer organizations having appropriate and relevant taskings to be performed, will provide the funding to the Consortium for transitioning technology to specific applications under the contract. No specific funding has been budgeted for the contract, and future budgetary efforts will be dependent on the success of the efforts under the Fundamental Research Component, as well as other events that may dictate the budgetary process. No funding from the Fundamental Research Component under the cooperative agreement shall be used for transition. The ceiling amount for the potential ten-year period of performance for the contractor in connection with the contract to be awarded is $90 million.

E. COLLABORATION

1. Background

Experience has shown that for many emerging technologies, high payoff is achieved through collaboration with a broad science and technology community. The US Army Collaborative Technology Alliances (CTAs) were designed to encourage collaboration. The Robotics CTA continues the ARL concept of an Alliance to facilitate a close relationship between ARL and its partners so that collaborative research can leverage and enhance individual efforts. It is ARL's strong belief that work conducted under the Robotics CTA cannot be successful either in whole or in part without collaboration. That is, collaboration between the members of the Consortium and the Government Members of the Alliance is integral to the execution of the Fundamental Research Component. Creation of an environment that is conducive to collaboration is therefore a critical element in establishing the Alliance. This section describes potential means to establish a collaborative environment including outreach activities and an on-line presence wherein scientific ideas can be exchanged efficiently in an open environment among all the partners in the Alliance, collaborative research among consortium and Government partners, and common research reviews. Offerors are invited to suggest additional new and innovative means for fostering collaboration among Alliance partners as part of their proposal.

2. Collaboration Environment

The ILO must provide an environment that promotes the collaborative research and management of the Alliance. Such an environment might be a web-based, password-protected system. The

ILO will provide a secure Internet-based environment for information sharing and interactive collaboration. An information repository will be maintained where ongoing research results, published papers and reports, research plans, interactive file sharing, discussion groups, interactive calendars of events, and other information can be accessed to enhance communication. This environment should support collaboration among Consortium members and between the Consortium and the Government and should support multi-level access control to protect sensitive information and intellectual property. The Consortium is expected to facilitate the integration and demonstration of integrated Alliance research results through this collaboration environment.

3. Lectures, Workshops, and Technical Reviews

The Alliance (i.e., the Consortium and ARL) may hold, from time to time throughout the period of performance of the Robotics CTA Program, technical lectures and workshops on mutually agreed upon topics. These lectures and workshops will serve as both educational and technical outreach opportunities and could involve participants outside the Alliance when appropriate. Additionally, the Alliance is expected to hold regular, periodic technical reviews that will permit the free exchange of ideas and research results, especially those impacting cross-cutting technical themes, among the entire ARL robotics research enterprise. The costs associated with the Consortium's efforts for these lectures, workshops and technical reviews will be funded under the Cooperative Agreement.

4. Education

As a means to foster the professional growth and technical strength of ARL and to provide a source for training personnel in fields underlying the Alliance, the Consortium will identify educational opportunities for Government scientists and engineers who perform research and development in fields related to the Fundamental Research Component. These opportunities may include fellowship programs that lead to masters and doctoral degrees, and short courses (e.g., summer and intensive special topic courses in critical technology areas) that lead to the award of appropriate academic credit.

The Consortium will further consider means to foster collaboration with ARL technical staff through programs such as internships at ARL for graduate and undergraduate students, and sabbaticals and summer study for faculty. The costs associated with the Consortium's efforts to identify, prepare for and execute such educational opportunities will be funded under the Cooperative Agreement. The cost associated with salaries, travel, etc. for Government personnel will be the responsibility of the Government, and will not be funded under the Cooperative Agreement.

5. Opportunities for Research Collaboration and Staff Rotation

A foundation of the CTA process is the rotation of technical staff through short- and long-term temporary assignments among the Alliance members. The scope of this collaboration may range from regular, periodic short term visits to sabbaticals lasting as long as a year. Staff rotations will be undertaken to foster and facilitate collaborative research where face-to-face interaction is

advantageous, to enable a researcher to utilize unique facilities, to enable Alliance personnel to obtain specialized training or experience, to permit close, direct interaction between research partners, and to facilitate the exchange of research results. In addition, this exchange, or cross fertilization, of personnel will provide Alliance personnel with insight into Army unique requirements and will provide Government personnel with insight into commercial practices or the opportunity to pursue fundamental research with noted researchers. The success of these interactive and collaborative exchanges will be assessed by the quality of the collaboration as demonstrated by joint efforts such as technology transitions, archival journal papers, patents, and refereed presentations. In the proposal offerors should outline the range of opportunities foreseen for collaboration and the mechanisms that will be put into place to foster staff rotations.

Opportunities exist for collaboration with the wider ARL research program and specifically with the Micro Autonomous Systems and Technology (MAST) CTA. Additional information concerning the ARL research program and the MAST CTA is available on the internet through the ARL webpage, i.e., http://www.arl.army.mil. Offerors are encouraged to develop plans for incorporation of this expertise as part of their proposal.

All salary and travel costs associated with the rotation of Government personnel will be borne by the Government. All salary and travel costs associated with staff rotations of Consortium members will be funded under the Cooperative Agreement or may be provided by the Consortium member as cost-share. There should be a balance of staff rotations across all the partners in the Consortium and across all the technical areas in the Alliance. It is anticipated that some portion of the Consortium's technical labor-years will be in staff rotations.

6. Demonstrations

A key aspect of collaboration between the Consortium, Government members of the Alliance, and other Government entities, is the ability for the Consortium to convincingly demonstrate technical progress achieved under the Robotics CTA. These activities will include demonstration of capabilities enabled by individual research tasks as well as performance achieved through the integration of multiple technologies into testbed platforms. While some portion of these demonstrations will be qualitative in nature, emphasis should be placed upon the development of quantitative performance data through carefully planned and structured experimentation employing both simulated and real environments.

In response to this PA, offerors will be expected to include a general plan for the integration of proposed research into representative testbeds and identify a plan for assessment of technology, from the level of each individual research task to integrated performance encompassing a wide array of relevant technology. The activities undertaken by the ILO will be key to the success of integration and technology assessment program that should involve collaboration among the entire Alliance. In the current CTA assessment activities have been conducted as a collaborative enterprise between Government partners, including the Army Research Laboratory and the National Institute of Standards and Technology (NIST), and the Robotics Consortium, in which the Consortium has been responsible for technology integration and development of data acquisition activities and the Government has led the experimental design, execution, and

analysis effort. Offerors are invited to propose other potential models for conducting collaborative technology assessments as part of the proposal.

Offerors are requested to detail unique facilities, instrumentation, and laboratories that they expect to use to demonstrate research results developed under the Robotics CTA. Such demonstration facilities may already exist, may be part of cost sharing proposed by the consortium, or may be proposed for purchase under the Robotics CTA within the funds allocated for each research area. Proposals should include plans for the maintenance and upkeep of any specialized equipment and testbeds to be employed by the Consortium in conducting technology integration and assessment activities. In addition to those facilities provided by the Consortium, the Government intends to continue to utilize existing and planned Government owned facilities such as the ARL Robotics Research Facility at Ft. Indiantown Gap, PA and related laboratory facilities at ARL sites at Aberdeen Proving Ground and Adelphi, Maryland to benefit the Alliance. Further information concerning ARL research and research facilities may be found at the ARL website http://www.arl.army.mil. Offerors should take these opportunities into consideration as they develop their proposals. Offerors are requested to detail the proposed methodology for conducting experimentation at various levels of complexity to obtain appropriate performance data and demonstrate technical progress, to foster collaboration among all members of the Alliance, and promote rapid transition of technology from the Alliance to other Army and DoD technology and acquisition programs.

E. MANAGEMENT

1. Background

It is critical that the Consortium be structured and managed to create and foster an open, collaborative research environment in which each member of the Consortium is an equal and to facilitate the transition of technology. This section describes a framework for the organization of Alliance and the Consortium. The framework is sparse and flexible to minimize overhead yet insure research relevance and proper oversight. Offerors can suggest additional management tools and mechanisms as part of the proposal, but in doing so they must also justify and demonstrate the benefit and cost effectiveness of these additional management activities.

2. Overall Management Concept

ARL and the winning Consortium will establish a Collaborative Research Alliance. Additionally, other Government agencies may be invited to join this Alliance and to contribute, as appropriate, their technical expertise, personnel, and access to research facilities. The Alliance will strive for a focused, yet flexible research environment. To accomplish this the Government proposes that the consortium consist of a small number of academic and industrial organizations, ideally with approximately six members, possessing significant expertise in one or more of the technical areas covered by the CTA led by a single organization, the Integration Lead Organization (ILO), with the ability to integrate the broad palette of technology required to create future highly autonomous unmanned systems and transition this technology to Advanced Development and acquisition programs. Each of these entities shall be a full member of the consortium and possess equal voting rights in accord with the Articles of Collaboration.

In addition to research conducted by members of the consortium, the annual research program will be enhanced by research undertaken by other organizations selected jointly by the Alliance as part of its annual planning process. Offerors are asked to suggest a detailed process for the selection and incorporation of these additional topics into the annual research program. These additional researchers and research organizations will be subawardees to one of the consortium members. Subawardee funding will be provided to the Consortium Member with which the Subawardee has or will have a legal relationship.

3. Technical Guidance and Oversight

The following flexible framework is suggested for the management and oversight of the Alliance. It consists of parallel managers from the Government and the Consortium who will provide day-to-day coordination, as well as a small managing board representing the interests of each of the Consortium members and a consultative group of interested parties from the Government. Offerors may propose additional plans or mechanisms for management; however, offerors are cautioned to ensure that any such plans or mechanisms are: (1) not duplicative of the requirements, and (2) not overly burdensome to the alliance. A description of each component of the Alliance Management follows:[1]

- **Collaborative Alliance Manager (CAM)**. The Fundamental Research Component executed under the Robotics CTA will be considered an extension and integral part of the US Army Research Laboratory (ARL) research program. As such, the program established under this PA will be planned, defended, executed, and reviewed as part of ARL's mission program. Overall technical management and fiscal responsibility for the Robotics CTA will reside with a senior ARL technical manager, who will be designated the CAM for the Robotics CTA under the cooperative agreement. The individual designated as the CAM will also be designated as the Contracting Officer's Representative (COR) for the contract for the Technology Transition Component. The ARL Grants Officer/Contracting Officer will receive recommendations from the CAM/COR and will be the ultimate legal authority empowered to make formal adjustments in the Robotics CTA, for both the cooperative agreement and the contract.

- **Program Director**. The Robotics CTA Program Director is the Consortium's technical representative charged with the Consortium's overall responsibility for management and guidance of the cooperative agreement. The Program Director will be designated by the ILO and be a member of that organization. The Robotics CTA is expected to be the primary responsibility of the individual assigned as Program Director, and a commitment of time commensurate with this responsibility is also expected.

- A **Research Management Board (RMB)** will be established to identify and develop collaborative opportunities, advise and assist the CAM in setting research goals, and facilitate transition to development programs. The RMB will include representatives from Army and

[1] Note: Offerors may propose additional plans or mechanisms for management; however, offerors are cautioned to ensure that any such plans or mechanisms are: (1) not duplicative of the requirements below and (2) not overly burdensome to the Alliance.

other service organizations and other government agencies with interest, expertise, or both in technologies related to the Robotics CTA. The RMB will be invited to the Annual Conference and the Annual Technical Review, and be informed about the Annual Program Plan approval process.

- **Consortium Management Committee (CMC).** The CTA will have a Consortium Management Committee (CMC) that consists of one representative from each member of the Consortium. The CAM participates as ex officio member in all discussions except those that deal with purely internal Consortium matters. The CMC will be chaired by the Program Director. Each Member will have one vote on the CMC to support programmatic and management-related activities and decisions. In the event of a tie, the ILO will cast the deciding vote. The CMC will be responsible for the management and integration of the Consortium's efforts under the Robotics CTA including programmatic, technical, reporting, financial, and administrative matters. The CMC makes recommendations that concern the membership of the Consortium, the definition of the tasks and goals of the participants, and the distribution of funding to the participants. Quarterly meetings will be conducted by the CMC.

4. Articles of Collaboration

The Articles of Collaboration define the operational structure within the Consortium. A sample for offerors to consider in formulating their proposals is provided on the Robotics CTA website found at http://www.arl.army.mil/www/default.cfm?Action=93&Page=392.

5. Initial Program Plan (IPP) and Annual Program Plan (APP).

Within 90 days after award, the Consortium (through the CMC) and the Government will jointly prepare an Initial Program Plan (IPP) to cover the first 9 months of performance. The IPP will be based substantially on the final proposals received from the Consortium. The IPP will be accompanied by a five-year roadmap that describes the overall plan to be accomplished by the Consortium within the Alliance structure. This roadmap should provide the vision for grand challenges and crosscutting themes to be addressed during the first five years of the Alliance. The roadmap should provide a detailed description of a well-coordinated plan of technology development and application, balancing theoretical and experimental elements of the program in each of the four technical areas. It should provide a clear plan for data collection, technology integration, and technology assessment activities to facilitate planning by all Alliance partners. It should provide approximate timelines for research activities to facilitate potential future technology transitions.

Eight months after award, the Consortium (through the CMC) and the Government will jointly prepare a proposed Annual Program Plan (APP) for the next fiscal year. Through discussion among the consortium members, an APP will result that enables integration and execution of crosscutting themes that strive to achieve Robotics CTA objectives. The APP will be presented to the RMB for comment and suggestions. The CAM will approve the APP and formally submit the approved APP to the Grants Officer for incorporation into the

cooperative agreement. This process will continue through the life of the cooperative agreement.

Each APP will cover a one-year timeframe, but may be altered, with the approval of the CAM and the Grants Officer, if research work requirements change. The APP will provide a detailed plan of research activities (including research goals, key personnel, educational opportunities, staff rotation, facilities, demonstrations and budget) that commits the Consortium to use their best efforts to meet specific research objectives. The APP will also describe the collaborative efforts with the Government. The APP will include, as a separate volume, a detailed description of the projects proposed to be undertaken by subawardees, including new subawardees that may be included at the discretion of the Government, and funded by up to a 10% withhold on the Consortium annual budget. In addition to the items normally outlined for each Consortium task in the APP, this appendix will demonstrate the novel nature of the research, the manner in which it complements the research being undertaken by the consortium, and how it is being integrated into the overall research enterprise.

During the course of performance, if it appears that research goals will not be met, the CMC will provide a proposed adjustment to the APP for approval by the CAM. In addition, the CAM may from time to time request that additional research be added to the APP within the scope of the cooperative agreement. The Consortium, as an entity, will not solicit or accept funding from outside sources other than the US ARL without the approval of the CAM and the Grants Officer.

During the course of performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the IPP/APP including but not limited to:

a. Changes in the scope or the objective of the program, IPP/APP, or research milestones;

b. Change in the key personnel specified in the IPP/APP;

c. The absence for more than three months, or a 25% reduction in time devoted to the project, by the approved project director or principal investigator;

d. The need for additional Federal funding; and

e. Any subaward, transfer, or contracting out of substantive program performance under an award, unless described in the IPP/APP.

The CAM, in coordination with the CMC and ARL management, will be responsible for integrating the IPP/APP into the overall respective research and technology programs.

During the course of performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the cooperative agreement including, but not limited to:

- Changes to the Articles of Collaboration if such changes substantially alter the relationship of the parties as originally agreed upon;

- Solicitation or acceptance of funding under the agreement from sources other than ARL; and
- Changes in Consortium membership.

6. Annual Workshops and Technical Reviews

The Alliance will be responsible for participating with ARL in an Annual Program Formulation Conference to display and present the results of its previous year's research and describe plans for the next year. Program overviews, posters, and exhibits and demonstrations will be presented or displayed to communicate the research products of the Robotics CTA. The Conference will foster interactions and collaborations among researchers. Planning for the Conference will be executed through the Program Director and the CAM.

7. Evaluation For Five-Year Extension

The Robotics CTA will be awarded for a five-year period beginning in FY10. There will be an option to extend the Robotics CTA for an additional five years. At the end of the fourth year, a program review will be conducted as directed by ARL. This review will consider cumulative performance metrics, the Consortium's vision for the additional five-year period of performance (to be submitted by the Consortium at the end of the fourth year), funding availability and the current fundamental research needs and goals of the US Army. Performance metrics are expected to include items that provide an indication of the Robotics CTA's accomplishments, such as transitions, the number of refereed journal articles, invited presentations, relevance of the work to ARL, collaboration, staff rotation, education, management**,** etc. The decision as to whether to exercise the option is expected to be based on the results of the review and evaluation described above.

8. Tracking Technology Transition

While it is expected that each Consortium Member will actively pursue technology transition to the Government as part of executing the Fundamental Research Component, it will be the responsibility of the ILO to briefly document and report to the Government on technology transition opportunities and events as they result from the Fundamental Research Component.

9. Distribution of Funding

The ILO will distribute the funding for the Fundamental Research Component to all members of the Consortium. Subawardee funding will be provided to the Consortium Member with which the Subawardee has or will have a legal relationship.

II. AWARD INFORMATION:

Offerors selected for award will be notified by the Contracting/Grants Officer or his/her designee telephonically or via email. Once notified the selected offerors will be required to sign the Cooperative Agreement and the Procurement Contract. The award is not official until the offeror

has signed the Cooperative Agreement and the Procurement Contract and the Contracting/Grants Officer has signed both documents.

III. ELIGIBILITY INFORMATION:

A. ELIGIBLE APPLICANTS

During performance it is envisioned that there will be Consortium Members as well as Subawardees performing under the Fundamental Research Component. The ILO has specific leadership and management responsibilities and roles as outlined below. Consortium Members are expected to have significant involvement and input on a long-term basis as outlined below. While Subawardees are expected to fulfill short-term needs as outlined below, they are particularly expected to execute new and innovative research covered by the 10% of overall funding that the Government reserves the right to withhold for this purpose. Thus, offerors are expected to consider carefully the construct of their proposed Consortium and effectively engage the appropriate Membership and Subawardee performance to achieve the goals of the Robotics CTA.

1. Consortium Membership:

To be qualified, potential Consortium Members must:

- be judged to have adequate financial and technical resources, given those that would be made available through the cooperative agreement, to execute the program of activities envisioned,
- have no known recent record of lack of responsibility or serious deficiency in executing such programs or activities,
- have no known recent record indicating a lack of integrity or business ethics,
- be otherwise qualified and eligible to receive an award under applicable laws and regulations.

2. There are two levels of Consortium Members:

a. Integration Lead Organization (ILO):

The ILO is required to possess existing significant operations in order to support research, technology integration, and technology transition activities associated with the Robotics CTA. Significant operations are defined as having the ability to perform research and support activities utilizing in-house engineers and scientists. The ILO has primary responsibility for the integration of technology, for demonstration and quantitative assessment of technology advancement and for the development, maintenance, and continual upgrade of required testbeds and specialized equipment and facilities necessary to assess integrated performance. The ILO has primary responsibility for articulating and executing a vision on cross-Consortium integration. This Member is expected to articulate a vision for the CTA, promote collaboration among Consortium Members, and members of the Alliance, and coordinate crosscutting themes with Alliance Members. This Member is required to administer, integrate, and manage the Consortium, participate in the research, and promote the transition of technologies resulting from the Fundamental Research Component of the Robotics CTA. This includes distribution of Government funding to Consortium Members in accordance with the approved IPP/APP under

the agreement. Leadership from this Member is expected to enhance the potential for transition of the resultant technology into both the commercial and military marketplaces.

b. Consortium Members:

Each Consortium Member must be an industrial or academic institution possessing substantial experience and expertise in one or more of the technical areas contained within the scope of the Robotics CTA. Under special considerations outlined below Federally Funded Research and Development Centers (FFRDC) may participate in the Consortium as a member. Academic members are expected to be advanced degree-granting educational institutions under the Higher Education Act of 1965 as amended. Those institutions are also expected to have doctoral level courses of study in related scientific and technical areas that can result in the granting of a doctoral degree. Industrial members are expected to have the ability to conduct appropriate research activities utilizing in-house engineers, scientists and facilities. Both academic and industrial members are expected to demonstrate opportunities for substantive collaboration with ARL, including appropriate opportunities for staff rotations and research collaboration.

3. Historically Black College or University/Minority Institution (HBCU/MI) Members: Army policy strongly encourages involvement of Historically Black Colleges and Universities (HBCU) or Minority Institutions (MI) in this effort. Accordingly a minimum of one Consortium member must be an HBCU/MI. HBCU, as used in this PA, means institutions determined by the Secretary of Education to meet the requirements of 34 Code of Federal Regulations (CFR) Section 608.2. The term also means any nonprofit research institution that was an integral part of such a college or university before November 14, 1986. MI, as used in this PA, means institutions meeting the requirements of the Higher Education Act of 1965 as amended (20 U.S.C. 1067k(3)). The term also includes Hispanic-serving institutions as defined in such Act (20 U.S.C. 1101a). ***At least 10% of the funding for the Consortium must be provided to HBCU/MI Member(s).***

4. Subawardees:

Consortium Members will be augmented with Subawardees to conduct specific research projects as necessary and appropriate to meet the goals of the Robotics CTA, especially for the conduct of new and innovative research for which they are particularly qualified. Subawardees are organizations that (1) are not expected to provide strategic input concerning the goals and direction of the Robotics CTA, (2) may possibly have only a short term relationship with the Consortium, and (3) are expected to have limited involvement in technology transition.

5. Federally-Funded Research and Development Centers (FFRDCs):

FFRDCs may participate as Consortium Members or Subawardees but may not be the ILO. Further, FFRDCs must cost-share an amount at least equal to the funding to be provided to them under the Robotics CTA.

B. COST SHARING OR MATCHING

Except for FFRDC members of a consortium, cost sharing is not required to be responsive to the PA. No level of cost sharing is stipulated; however it is encouraged. During the evaluation of proposals, cost sharing will be evaluated as it relates to the evaluation factors listed in the PA, based on the degree to which the proposed cost sharing enhances the proposal to result in added benefits to the Robotics CTA Program. In order for the proposed cost sharing to receive appropriate credit during the evaluation process, the proposal should evidence **a firm commitment** to provide such cost share and also evidence **a process for integrating the cost share into the collaborative research program**.

IV. APPLICATION AND SUBMISSION INFORMATION

A. APPLICATION PROCESS

Proposals shall be submitted electronically through the www.grants.gov portal. Proposals sent by fax or email will not be considered.

Registration Requirements for www.grants.gov: There are several one-time actions that an offeror must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider, and register with Grants.gov). See www.grants.gov/GetStarted to begin this process. Use the Grants.gov Organization Registration Checklist at www.grants.gov/assets/OrganizationRegCheck.doc to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants, who are not registered with CCR and Grants.gov, should allow at least 21 days to complete these requirements. It is suggested that the process be started as soon as possible.

Questions: Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov.

B. CONTENT AND FORMAT OF APPLICATION SUBMISSION

Application forms and instructions will be available at Grants.gov. To access these materials, go to http://www.grants.gov, select "Apply for Grants", and then select "Download Application Package." Enter the funding opportunity number, W911NF-08-R-0012.

NOTE: Compatible versions of Adobe Reader are currently 8.1.1 and 8.1.2. You will be asked to specify your Operating System (examples: Windows, Mac) and Version (examples: XP, Vista, 10.4.9) be sure to specify Adobe Reader Version 8.1.2 to get the compatible version to apply for grants on Grants.gov. Click here to download version 8.1.2 from Adobe Website: http://www.adobe.com/products/acrobat/readstep2_allversions.htm.

Offerors must complete the mandatory forms and any optional forms (e.g., SF-LLL Disclosure of Lobbying Activities) in accordance with the instructions on the forms and the additional instructions below. The required fields should be completed in accordance with the "pop-up" instructions on the forms. To activate the instructions, turn on the "Help Mode" (icon with the pointer and question mark at the top of the form). Files that are attached to the forms must be in Adobe Portable Document Form (PDF) unless otherwise specified in this announcement.

The following formatting rules apply for the file attachments:

Paper size when printed – 8.5 x 11 inch paper
Margins – 1 inch
Spacing – single
Font – No smaller than Times New Roman, 10 point

Form: SF 424 (R&R) (Mandatory) – Complete this form first to populate data in other forms. Authorized Organization Representative (AOR) usernames and passwords serve as "electronic signatures" when your organization submits applications through Grants.gov. By using the SF 424 (R&R), offerors are providing the certification required by 32 CFR Part 28 regarding lobbying.

Form: Research & Related Other Project Information - Complete questions 1 through 5 and attach files.

Project Summary/Abstract (Field 6 on the form) - The Project Summary should be a brief abstract that summarizes the content of the Fundamental Research Component of the proposal. The project summary must not exceed 5 pages. Pages in excess of the page limit may be removed for the evaluation of the proposal.

- Project Narrative (Field 7 on the form) - Chapters and Numbers of pages – Field 7 is to contain the chapters set forth below and may not exceed the stipulated page counts for those chapters. Pages in excess of the page limits may be removed for the evaluation of the proposal.
- Chapter 1 - **Fundamental Research Component**. The pages included in Chapter 1 shall be numbered. Offerors are advised that Chapter 1 **shall not exceed 75 pages**, utilizing one side of the page.
- Chapter 2 – **Technology Transition Component**. The pages included in Chapter 2 shall be numbered. Offerors are advised that Chapter 2 of the proposal **shall not exceed 20 pages**, utilizing one side of the page.
- Chapter 3 - **Program Management** . The pages included in Chapter 3 shall be numbered. Offerors are advised that Chapter 3 of the proposal **shall not exceed 20 pages**, utilizing one side of the page.
- Chapter 4 – **Biographical Sketches** - Biographical sketches shall be limited to two (2) pages per individual, with no limitation on the number of individuals .

Bibliography and References Cited (Field 8 on the form) - Attach a listing of applicable publications cited in above sections.

Facilities and Other Resources (Field 9 on the form) - The offeror is to include a listing of facilities and other resources available to support the proposal. Any Government resources necessary for performance are to be clearly identified. Attach this information at Field 9.

Equipment (Field 10 on the form) - The offeror is to include a listing of equipment available to support the proposal. Any Government equipment necessary for performance is to be clearly identified. Attach this information at Field 10.

Other Attachments (Field 11 on the form) are as follows:

1. Attached the completed Proposal Cover Sheet. (See Paragraph IV.F below.)

2. Attached the completed certifications. (See Paragraph VI.B below.)

3. Attach any exceptions or conditions to the Model Cooperative Agreement or Model Technology Transition Contract. (See http://www.arl.army.mil/www/default.cfm?Action=93&Page=392 for these documents.)

4. Attach the signed Articles of Collaboration for all Members. (See http://www.arl.army.mil/www/default.cfm?Action=93&Page=392 for a sample document.)

5. Attach the Cost Proposal. **Cost Proposal shall include the entire cost submission for the Fundamental Research Component for the first five years of performance. (The Consortium will be requested to provide a complete cost proposal for the optional five-year period of performance as part of the evaluation to be completed prior to making the decision concerning this optional period.)** The cost portion of the proposal shall contain cost estimates sufficiently detailed for meaningful evaluation. For budget purposes, assume a performance start date of **1 January 2010.** The proposed amounts shall not exceed the funding ceilings identified in the **FUNDAMENTAL RESEARCH COMPONENT** of this PA. For all proposals, the elements of the budget should include:

- Direct Labor - Individual labor category or person, with associated labor hours and unburdened direct labor rates.

- Indirect Costs - Fringe benefits, overhead, G&A, etc. (must show base amount and rate). Justify.

NOTE: Initially, this agreement is expected to be funded partially with FY10 basic research funds. Both the Defense Appropriations Acts of 2008 and 2009 contained a provision such that no basic research funds made available under the acts could be used to pay indirect costs that exceed thirty-five percent of the total amount of the agreement for basic research. Further, the acts indicated that indirect costs exceeding thirty-five percent of the total amount to be reimbursed from that appropriation would be considered unallowable and would not be reimbursed. Further it stated that should subsequent audits indicate indirect costs exceeding thirty-five percent of the total amount paid from the appropriation were disbursed, the recipient would be required to refund the amount over the statutory limitation to the Government. While it is unknown whether such a

provision will be included in the Defense Appropriation Act of 2010, offerors are to indicate in their cost proposals their plan for compliance with such a provision, should such be included in the Defense Appropriation Act of 2010.

- Travel - Number of trips, destination, duration, etc. Justify and include basis for costs.
- Subaward - A cost proposal, as detailed as the offeror's cost proposal, will be required to be submitted by each proposed subrecipient.
- (NOTE: A cost proposal is not required for subawardees after FY12; however, offerors are to provide some basis for the subawardee costs proposed after FY12.
- Consultant - Provide consultant agreement or other document that verifies the proposed loaded daily/hourly rate. Include a description of the nature of and the need for any consultant's participation. Provide budget justification.
- Materials - Specifically itemized with costs or estimated costs. An explanation of any estimating factors, including their derivation and application, shall be provided. Include a brief description of the offeror's procurement method to be used (competition, engineering estimate, market survey, etc.). Justify.
- Other Directs Costs - Particularly any proposed items of equipment or facilities. Equipment and facilities generally must be furnished by the recipient (justifications must be provided when Government funding for such items is sought). Include a brief description of the offeror's procurement method to be used (competition, engineering estimate, market survey, etc.). Justify.

All entities, i.e. Consortium Members and Subawardees, included in the cost proposal for the Fundamental Research Component are to provide detailed information on all cost elements included in their proposed budgets as part of the proposal submission process. However, it is recognized that some entities may choose to submit their proprietary rate information directly to the Government in lieu of providing such information to the ILO for inclusion in the cost proposal submitted through grants.gov. In such a case, a separate submission can be made directly to the Government. Such a submission MUST include the PA Number, i.e. W911NF-08-R-0012, and the name of the ILO associated with the proposal on the mailing envelope submitted to the following address:

U.S. Army RDECOM Contracting Center
RTP Contracting Division
ATTN: W911NF-08-R-0012/MORSE
4300 S. Miami Blvd.
Durham, NC 27703

NOTE: All such separate submissions must arrive NLT than the due date and time for the proposal submission through grants.gov to be considered. Further, for all such submissions summary cost information must be provided to the ILO for the grants.gov submission that is sufficient in detail for the Government to use in the evaluation of the cost proposal for cost realism, and can be clearly mapped to the proprietary rate information submitted directly to the Government.

SF-LLL - Disclosure of Lobbying Activities

If applicable, attach a complete SF- LLL at Field 11 of the R&R Other Project Information form. Applicability: If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the grant/cooperative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying."

C. SUBMISSION DATES AND TIMES

Proposals are due by 3:00pm (local North Carolina time) on Thursday, 12 March 2009.

After a proposal is submitted through Grants.gov, the Authorized Organization Representative (AOR) will receive a series of three e-mails. It is extremely important that the AOR watch for and save each of the e-mails. Offerors will know that the proposal has been properly received when the AOR receives e-mail Number 3. Retain the Submission Receipt Number (e-mail Number 1) to track a submission. The three e-mails are:

Number 1 – The applicant will receive a confirmation page upon completing the submission to Grants.gov. This confirmation page is a record of the time and date stamp for the submission.

IMPORTANT: Once email number 1 has been received, please forward this email to Mr. Joseph (Skip) Morse of the U.S. Army RDECOM Contracting Center at Joseph.Morse @us.army.mil. This email may be used by the Government for verification of the timeliness of the proposal submission!

Number 2 – The applicant will receive an email indicating that the proposal has been validated by Grants.gov within a few hours of submission. (This means that all of the required fields have been completed.)

Number 3 – The third notice is an acknowledgment of receipt in email form from the designated agency within ten days from the proposal due date. The email is sent to the authorized representative for the institution. The email for proposals notes that the proposal has been received and provides the assigned tracking number.

Provisions for Late Submissions of proposals are included as part of the Federal Acquisition Regulation (FAR) provision at 52.215-1 (c)(3), incorporated by reference in the Model Contract (Solicitation). (See https://www.arl.army.mil/www/default.cfm?Action=93&Page=392 for this document.)

D. INTERGOVERNMENTAL REVIEW - NOT APPLICABLE

E. FUNDING RESTRICTIONS - SEE PARAGRAPH I.B.4 ABOVE.

F. OTHER SUBMISSION REQUIREMENTS

The following Proposal Cover Sheet is required to be submitted by each offeror:

PROPOSAL COVER SHEET

1. Information concerning the Integration Lead Organization proposal (points of contact (POC)):

Technical POC: _____
Phone No.: _____
Fax No.: _____
Email Address _____

Business POC _____
Phone No.: _____
Fax No.: _____
Email Address: _____

2. List the names and relationships of all organizations included in the proposal:

ILO _____

Consortium Member(s) _____
_____
_____

Subawardees/Subcontractors _____
_____
_____

3. Provide a point of contact for each organization included in the Cost Proposal. These individuals may be contacted for questions concerning the Cost Proposal:

Organization: _____
POC: _____
Phone No.: _____
Email Address _____

4. Signature of one person for the proposed Integration Lead Organization, and one person from each proposed Consortium Members, authorized to submit a proposal and bind that organization: (These signatures may be provided on separate sheets.)

Organization Name: _____
Signature: _____
Type Name/Title: _____
Date (Proposal): _____

V. APPLICATION REVIEW INFORMATION

A. CRITERIA

All information necessary for the review and evaluation of a proposal must be contained in the proposal. No other material will be provided to the evaluators. Proposals should contain sufficient technical detail to allow for in-depth technical evaluation.

An initial review of the proposals will be conducted to ensure compliance with the requirements of this PA. Failure to comply with the requirements of the PA may result in a proposal receiving no further consideration for award.

A Source Selection Evaluation Board (SSEB) will review the proposals. The SSEB, consisting of qualified groups of scientists, managers, and cost specialists, will evaluate each proposal and provide the results of that evaluation to the Source Selection Authority (SSA). The SSA will make decisions concerning the competitive range and award selection.

If negotiation discussions are held, ARL anticipates such to be located at the site of each offeror. Any such meetings will be coordinated with the offerors at the appropriate time.

Proposals submitted in response to this PA will be evaluated against the evaluation factors set forth below, using an adjectival and color rating system. Cost will be evaluated for realism, reasonableness, and affordability. Evaluators will identify strengths, weaknesses and clarifications concerning the proposal. Information from any and all proposal volumes may be used for any and all evaluation areas described above.

Fundamental Research Component

Factors (a-e): Technical Merit, Relevance, and Credentials. The Robotics CTA is a long-term, evolving research effort focused upon furthering the ability to develop future autonomous unmanned systems. Therefore the evaluation of this factor will concentrate on the overall scientific and technical merit of the proposal, including its creativity, innovation, feasibility, efficacy, and likelihood of achieving the stated objectives of the proposed research over the lifetime of the CTA, for both the Basic Research and Applied Research elements of the program; the offerors understanding of the Army's goals for unmanned systems and the relevance of the proposed technical plan to achieving those goals; and the breadth and depth of knowledge and relevant experience of the principal researchers designated to be part of the Consortium.

The evaluation of this factor will examine the overall proposed technical vision for future robotic system capabilities, identification of the significant technical barriers to achieving this vision, description of the proposed pathway towards overcoming those barriers, and descriptions of specific proposed research efforts and milestones that are anticipated to be achieved in the near- (first two years), mid- (following three years), and far-term (option years) in each of the four technical areas and as an integrated solution. It will examine the responsiveness of the proposal to the Army's Vision (available at http://www.army.mil), Future Operating Capabilities and

Functional Operating Concepts (available at http://www.tradoc.army.mil/tpubs/pamndx.htm). It will evaluate proposed mechanisms for maintaining relevancy throughout the life of the Alliance and fostering transition of research results to Advanced Development and acquisition programs. Finally, it will examine the qualifications, capabilities, availability and experience of the proposed research personnel individually and as a whole, to achieve the objectives of the proposed research program.

Thus, a viable proposal would include for both the Basic Research and Applied Research elements of the program, a concise statement of the offeror's vision of anticipated Robotics CTA outcomes, its relevance to the Army's vision, technical barriers to attaining these objectives, and a roadmap towards achieving those objectives within the lifespan of the CTA. It would contain a complete discussion of the technical approaches to be pursued, alternative paths towards attaining the stated goals and the rationale for discarding those approaches. It would provide evidence of successful technology integration and a rational plan for the continual quantitative assessment of research progress and enhanced capabilities. It would clearly identify those elements of the proposed effort that are considered to be Basic Research and those considered to be Applied Research. It would contain a cross-walk demonstrating how achievement of specific technical goals contained in the proposed research plan assist in attainment of recognized Army operational goals. It would demonstrate prior experience in the successful transition of research products to Advanced Development or acquisition programs. Finally, it would include the names, brief biographies and availability of key personnel substantially and meaningfully engaged in the research, including listings of seminal publication in the scientific literature and examples of technical contributions that have been transitioned into development programs.

Factor (a): Technical Merit, Relevance, and Credentials for proposed research in perception.

Factor (b): Technical Merit, Relevance, and Credentials for proposed research in intelligence.

Factor (c): Technical Merit, Relevance, and Credentials for proposed research in human-robot interaction.

Factor (d): Technical Merit, Relevance, and Credentials for proposed research in dexterous manipulation and unique mobility

Factor (e): Technical Merit, Relevance, and Credentials for proposed integrated research program. This factor will examine the overall merit of the proposed program as an integrated technical solution, including proposed efforts for quantitative assessment of technical capabilities.

Factor (f): Collaboration. This factor will focus upon the plans enunciated by the consortium for developing research and programmatic collaboration among all members of the Alliance. Evaluation of this factor will examine plans and mechanisms foreseen by the offeror to involve all members of the Alliance into an integrated research program, including proposed processes for selection of subawardees to conduct innovative research and development of research

opportunities for Government personnel. It will evaluate the process for integration of disparate research tasks into appropriate vehicles to demonstrate enhanced integrated performance by unmanned systems. It will examine proposed educational opportunities for Government personnel. It will evaluate the proposed program of technology workshops and program reviews designed to propagate research results to the community. It will examine proposed intra-consortium collaboration, including the development of research activities involving multiple partners, staff rotations, and the enhancement of research infrastructure and opportunities for the HBCU/MI participants.

Thus, a viable proposal would put forth clear plans to meet each of the evaluation criteria listed in the preceding paragraph. It would propose mechanisms demonstrating creativity and resourcefulness for fostering true intra-consortium and intra-alliance collaboration.

Factor (g): Facilities and Equipment. This factor will examine the adequacy and appropriateness of facilities and equipment proposed by the offeror to conduct the technical program and plans for maintenance and continual upgrading of testbeds and equipment. Evaluation of this factor will focus upon the extent to which the proposed facilities and equipment contribute to the accomplishment of the proposed research program. It will evaluate the ability of proposed facility to support the proposed plan for demonstration and assessment of technology. It will demonstrate plans for sharing of facilities among the entire Alliance, including plans for utilization of Government facilities. It will examine the offeror's plans for maintaining specialized facilities, testbeds, and equipment necessary for technology integration and assessment activities.

Thus, a viable proposal would identify all facilities and specialized equipment (including those contributed as part of cost-sharing) proposed by the offeror, indicating how these facilities & equipment, when combined with Government assets, will permit the Alliance to meet the proposed objectives of the Robotics CTA. It would demonstrate how these assets will facilitate intra-consortium and intra-alliance collaboration, especially with HBCU/MI members. It would demonstrate how the assets will enable demonstration of capabilities for ultimate transition to advanced development and acquisition programs. It would provide a detailed plan for the continual maintenance and upgrading of specialized facilities, testbeds and equipment throughout the lifetime of CTA, including required technician staff, etc., to fulfill the proposed program of technology integration, demonstration, and assessment.

Technology Transition Component

Factor (h): Past Performance. Evaluation of this factor will focus on the offeror's proposed plan to promote rapid transition of research products into US Army development programs as well as commercial applications. It will examine its demonstrated experience transitioning technologies from the research stage into development programs. The proposal should include a description of the planned process for transition, as well as anticipated Consortium activities to aid in generating external awareness of Alliance research activities. The proposal should include examples of successful past or current transitioning experience, and provide the contract number(s) and point(s) of contact (names, addresses, and telephone numbers) of Government personnel who can attest to the success of these examples. Offerors are encouraged to provide

information on problems encountered on the identified contracts and the offeror's corrective actions. Offerors without a record of relevant past performance or for whom information on past performance is not available, will not be evaluated favorably or unfavorably for this evaluation factor.

Factor (i): Subcontracting. Evaluation of this factor will focus on the offeror's past performance in meeting subcontracting plan goals, including specifically their small business goals and their small disadvantaged business goals. Offerors should provide contract number(s) and point(s) of contact of Government personnel who can attest to this information. Offerors without a record of relevant past performance or for whom information on past performance is not available, will not be evaluated favorably or unfavorably for this evaluation factor. While the specific transition tasks to be performed are dependent on the results of the research program and are not yet known, evaluation of this factor will also include the offeror's plan for subcontracting, specifically identifying planned types of efforts to be performed by small businesses, small disadvantaged businesses and HBCU/MIs. With respect to the subcontracting evaluation factor, offerors that are small businesses will receive the highest rating.

Management

Factor (j): Management. This factor will focus upon the plan for managing execution of Consortium activities over the lifetime of the Alliance. Evaluation of this factor will focus on the offeror's plan to comply with the requirements of the overall management concept; including the proposed Articles of Collaboration; mechanisms for development of a comprehensive program plan; outreach to incorporate the most innovative and promising technologies into the research plan; leadership and management to be provided by the Program Director; procedures to oversee and maximize technical progress; concepts to foster collaboration particularly with Government researchers; specifics of the internet based collaborative work environment; and controls to assure timely submission of consortium invoices to the Government. The offeror should demonstrate a viable management approach by providing a feasible, comprehensive management plan considering each of the evaluation criteria listed above.

Cost

While this area will not be weighted, evaluation of this area will consider cost realism, cost reasonableness, and affordability within funding constraints. The Government may make adjustments to the cost of the total proposed effort as deemed necessary to reflect what the effort should cost. These adjustments shall consider the task undertaken and technical approach proposed. These adjustments may include upward or downward adjustments to proposed labor hours, labor rates, quantity of materials, price of materials, overhead rates and G&A, etc.

Relative Importance of Evaluation Criteria

The relative importance of the evaluation factors within this PA are as set forth below:

The combined weight of the evaluation factors associated with the Fundamental Research

Component is more than the combined weight of the evaluation factors associated with both the Technology Transition Component and Management. Within the Fundamental Research Component, Evaluation Factor (e) has the greatest weight and Factors (a) through (d) are of approximately equal weight; and Factors (f) and (g) are in descending order of importance and are lower in weight than individual factors (a) through (e). Within the Technology Transition Component, Evaluation Factors (h) and (i) are approximately equal in importance.

B. REVIEW AND SELECTION PROCESS

Proposals received in response to this solicitation will be evaluated using formal source selection procedures. Award will be based on an integrated assessment of each offeror's ability to satisfy the requirements of the PA. The Government anticipates that discussions with offerors will be conducted; however, the Government reserves the right to make award without discussions. A competitive range may be established for any discussions. If discussions are held, offerors in the competitive range will be invited to submit Final Proposal Revisions, which will be evaluated using the same procedures used with the initial proposals. The Government will make award to the Consortium that offers the best value to the Government, conforming to the PA, cost and other factors considered. Further, award may be made to other than the offeror who offers the lowest cost proposal.

VI. AWARD ADMINISTRATION INFORMATION

A. AWARD NOTICES

Should your proposal be selected for award, you will be contacted telephonically or via email by the Grants/Contracting Officer or his/her representative. At that time the offeror will be asked to execute both the Cooperative Agreement and the Contract. Award is not made until it each award document is signed by both the successful offeror and the Grants/Contracting Officer.

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

Offerors are to complete the following certifications to be submitted with the proposal:

1. CERTIFICATION REGARDING LOBBYING

This certification is required for an award of a Federal contact, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying," In accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contacts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure

Organization (Offeror): _____

Signature: _____

Typed Name: _____

Title: _____Date: _____

2. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS-PRIMARY COVERED TRANSACTIONS

(1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

(2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization (Offeror): _____

Signature: _____

Typed Name: _____

Title: _____ Date: _____

3. CERTIFICATION REGARDING DRUG-FREE WORKPLACE REQUIREMENTS

A. The recipient certifies that it will or will continue to provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing an ongoing drug-free awareness program to inform employees about –

(1) The dangers of drug abuse in the workplace;

(2) The recipient's policy of maintaining a drug-free workplace;

(3) Any available drug counseling, rehabilitation, and employee assistance programs; and

(4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);

(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the cooperative agreement, the employee will –

(1) Abide by the terms of the statement; and

(2) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;

(e) Notifying the agency in writing, within ten calendar days after receiving notice under paragraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification number(s) of each affected grant or cooperative agreement;

(f) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (d)(2), with respect to any employee who is so convicted –

(1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;

(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e) and (f).

B. The recipient may insert in the space provided below the site(s) for the performance of work done in connection with the proposed cooperative agreement:

Place of Performance (Street address, city, county, state, zip code)

_____

_____

_____

Check mark if there are workplaces on file that are not identified here.

Organization (Offeror): _____

Signature: _____

Typed Name: _____

Title: _____ Date: _____

C. REPORTING

Reporting requirements for the Cooperative Agreement are contained in the Model Cooperative Agreement - (See https://www.arl.army.mil/www/default.cfm?Action=93&Page=392 for this document.) Reporting requirements for the Technology Transition contract will be contained in Task Orders issued under this contract.

VII. AGENCY CONTACTS

Questions or comments concerning this PA will be posted through the Robotics CTA website at www.arl.army.mil/robotics. Questions and comments should be concise and to the point. In addition, the relevant part and paragraph of the PA should be referenced. Responses to questions

received will be posted to the Robotics CTA website for the benefit of all interested parties. Should an offeror have questions they believe are of a proprietary nature, the offeror must clearly state so in the question when posed. Answers to questions of a proprietary nature will be provided via email directly to the poser of the question. A location on the website will be provided for potential offerors to post their availability for teaming with others.

VIII. OTHER INFORMATION - NOT APPLICABLE